COTTAGERS SELF-HELP PROGRAM ENRICHMENT STATUS OF THIRTY-FOUR LAKES IN THE SOUTHEASTERN REGION OF ONTARIO 1976

Ministry of the Environment
Ontario

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COTTAGERS' SELF-HELP PROGRAM

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1976

by

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Technical Support Section

Ministry of the Environment

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Enrichment Status of Thirty-four Lakes
in the Southeastern Region of Ontario
1976

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ABSTRACT

This report presents Secchi disc and chlorophyll data collected from 50 lakes in the Southeastern Region of Ontario during the summer of 1976. An attempt is made to define the enrichment status of 34 of these lakes for which six or more sets of measurements are available. The data were collected through the assistance of volunteers who took Secchi disc readings and water samples from lakes on which they were situated. The results provide the Ministry of the Environment with an excellent means of monitoring water quality in our recreational lakes and of investigating any cases of deteriorating water quality and suggesting possible corrective action.

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- Sharbot Lake Provincial Park

Ministry of the Environment
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Through the efforts of these volunteers the Ministry of the Environment has been able to assemble valuable water quality data which would not otherwise be available. This is a significant contribution to the maintenance of water quality in our recreational lakes.

INTRODUCTION

Over the past years, an increasing awareness of a concern for problems of water quality impairment in our recreational lakes has materialized. The Ontario Ministry of Environment and other government agencies involved in the control and management of shoreline development of cottages and resorts are concerned with the maintenance of good water quality. In 1970, the Ontario Ministry of Environment established a recreational lake program which is a continuing study to collect and assess data on lakes in the Province to ensure that future development and recreational use of these waters will be well managed to protect their quality.

With the many hundreds of lakes in our region, we do not have the resources to conduct intensive surveys on all lakes annually, nor are such surveys necessary to monitor water quality of our recreational waters on a routine basis. In 1971, a relatively simple but effective "Self-Help Program" was introduced in which cottagers' associations and individual lake residents volunteer their time to measure the clarity of their lake and to collect water samples at weekly intervals. The volunteers are supplied with the necessary sampling equipment, bottles and instructions and are asked to ship the water samples to the nearest Ministry of the Environment

Laboratory where they are analyzed for their algae content as reflected by chlorophyll levels. The success of the program is exemplified by the fact that the number of lakes included in the program increased from 12 in the first year of its operation to well over 100 in 1975.

This report presents the data collected from 50 lakes in the Southeastern Region of Ontario during the summer of 1976 (see Table 1), incorporates the information into a graphical relationship for 34 lakes with six or more measurements, and comments on the findings in an attempt to define degree of aquatic enrichment or trophic status of each lake. Appendix A provides a brief explanation of water quality problems in recreational lakes. The Southeastern Region includes Hastings and Renfrew Counties and extends eastward to the Quebec border.

Table 1: Lakes in the Southeastern Region which were sampled in 1976 as a part of the Self-Help Program.

LAKE		LOCATION
1.	Adams	North Burgess Twp., Lanark County
2.	Baptiste	Herschel Twp., Hastings County
3.	Beaver	Sheffield Twp., Lennox & Addington County
4.	Rig Rideau	North Burgess and North Elmsley Twps., Lanark County and Bastard, South Burgess and South Elmsley Twps., Leeds County
5.	Black	Olden Twp., Frontenac County
6.	Bobs	Bedford Twp., Frontenac County
7.	Boulter	McClure Twp., Hastings County
8.	Buck	Loughborough, Bedford & Storrington Twps., Frontenac County
9.	Charleston	Rear of Yonge and Escott and Lansdowne Twps., Leeds County
10.	Christie	Sherbrooke and Bathurst Twps., Lanark County
11.	Clarendon	Clarendon and Barrie Twps., Frontenac County
12.	Clear	Sebastopol Twp., Renfrew County
13.	Collins Bay	Kingston Twp., Frontenac County
14.	Coulonge	Westmeath Twp., Renfrew County
15.	Crowe	Marmora Twp., Hastings County and Belmont Twp., Peterborough County
16.	Dalhousie	Dalhousie Twp., Lanark County
17.	Devil	Bedford Twp., Frontenac County
18.	Dropledge	Raglan Twp., Renfrew County
19.	Garvin	Grattan Twp., Renfrew County
20.	Glanmire	Tudor Twp., Hastings County

LAKE		LOCATION
21.	Golden Lake	North Algona Twp., Renfrew County
22.	Green	Brougham Twp., Renfrew County
23.	Grippen	Rear of Leeds Twp., Leeds County
24.	Hay Bay	Fredicksburg Twp., Lennox & Addington County
25.	Little Silver	South Sherbrooke Twp., Lanark County
26.	Joe Perry	Abinger Twp., Lennox & Addington County
27.	Kamaniskeg	Sherwood, Radcliffe, Bangor and Jones Twps., Renfrew County
28.	Kennebec	Kennebec Twp., Frontenac County
29.	Leatheroot	Denbigh Twp., Lennox & Addington County
30.	Limerick	Limerick Twp., Hastings County
31.	Loughborough	Storrington Twp., Frontenac County
32.	Mackie	Miller Twp., Frontenac County
33.	Mazinaw	Abinger Twp., Lennox & Addington County
34.	Mink	Wilberforce Twp., Renfrew County
35.	O'Brien	Griffith Twp., Renfrew County
36.	Ottawa River	Hawkesbury East Twp., Prescott County
37.	Otter	Bastard and South Elmsley Twps., Leeds County
38.	Otty	North Burgess and North Elmsley Twps., Lanark County
39.	Pike	North Burgess Twp., Lanark County
40.	Presqu'ile Bay	Ameliasburg Twp., Prince Edward County
41.	Upper Rideau	North Crosby Twp., Leeds County
42.	Round L.	Hagarty & Richards Twps., Renfrew County

LAKE		LOCATION
43.	Salmon Trout	Monteagle Twp., Hastings County
44.	Sharbot	Olden Twp.,Frontenac County
45.	Shavings	Sebastopol Twp., Renfrew County
46.	St. Peter	McClure Twp., Hastings County
47.	Steenburg	Limerick & Tudor Twps., Hastings County
48.	Temperance	Rear of Yonge & Escott Twp., Leeds County
49.	White	Darling Twp., Lanark County
50.	White	Olden Twp., Frontenac County

METHODS

Water clarity which governs the depth of light penetration into a lake is one of the most important parameters used in defining water quality and can be measured using a Secchi disc. The disc which measures 20 cm in diameter and is divided into black and white alternating quadrants is lowered into the water on a graduated line until the quadrants cannot be distinguished. The depth is noted and the disc is raised slowly until the quadrants are just visible - again the depth is noted. The average of these two depths is termed the Secchi disc depth. As depicted in Figure 1, Secchi disc depths are substantially greater in lakes having low phytoplankton (microscopic free-floating algae) numbers than in lakes characterized by high algal densities. Secchi disc readings were taken as often as possible during the summer in the deep-water zones of the lakes.

Chlorophyll is a photosynthetic green pigment in algae and its concentrations can be used as a rough indication of the extent of biological activity in a lake at the time of sampling since it is regulated by all of the combined physical, chemical and biological factors which affect algal production. Chlorophyll samples were taken at routine intervals by lowering a narrow-mouthed bottle (32 ounce capacity) to the approximate

depth of the 1% incident light level, or through the surface zone of effective algal production. The extent of this zone was determined by doubling the value of the Secchi disc depth. The speed of lowering and raising the bottle was regulated so that the bottle was just filled when it reached the surface, the object being to collect a composite water sample equally representative of all depths of the measured water column. The samples were preserved immediately after collection with 10 to 15 drops of a 2% magnesium carbonate suspension to minimize degradation of the chlorophyll pigment, and were delivered as soon as possible, usually within a day or two, to a Ministry of Environment laboratory. They were filtered using a 1.2 micron filter paper, wrapped in aluminium foil to prevent light from reaching the residue and refrigerated pending final analysis by the Ministry's Laboratory Services Branch in Toronto.

Secchi disc readings and water samples for chlorophyll analyses were collected at weekly or bi-weekly intervals over as much as possible of the ice-free season, depending on the samplers' availability at their lake.

The "Secchi Disc Reading" is obtained by averaging the depth at which a 20cm (8") dia. black and white plate, lowered into the lake just disappears from view and the depth where it reappears as it is pulled up.

Most of the free-floating algae are suspended in the illuminated region between the lake surface and 2 times the Secchi disc reading.

Clear, algae-free lake: Secchi disc readings tend to be greater than 3m (9 feet).

Turbid or algae-rich lake: Secchi disc readings tend to be less than 3m (9 feet).

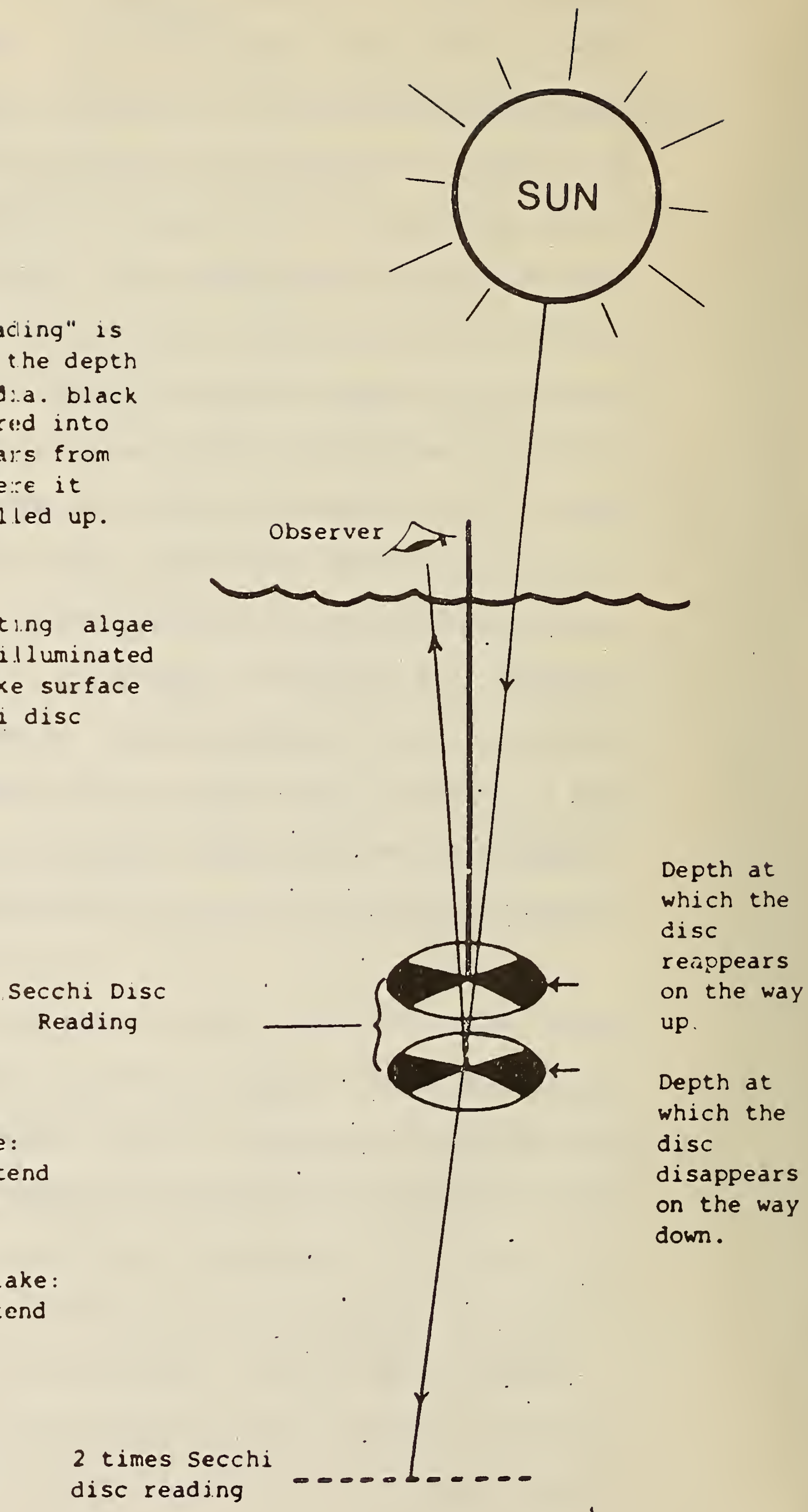


Figure 1: Diagram illustrating the use of a Secchi disc to measure water clarity.

DISCUSSION OF RESULTS

The mean Secchi disc and chlorophyll a values for the 34 lakes with six or more sets of measurements are summarized in Table 2 and individual results for all 50 lakes sampled during 1976 are presented in Table 4. Some of the lakes are represented by more than one sampling station. This is necessary for a lake that is divided into two or more basins or contains a number of bays that may act independently from a water quality point of view. It should be recognized that, in many cases, the data represent conditions during the summer months only, and therefore the absence of heavy algal growths in the spring or fall cannot be confirmed. Some discretion should also be exercised when comparing some of these lakes since the dates and number of measurements vary considerably from lake to lake. For example, only six sets of measurements were obtained between July 4 and September 5 for Mud Bay of Bobs Lake, while 37 sets were acquired between May 23 and October 3 from Otty Lake. Consequently, a more realistic appraisal can be made of the enrichment status of Otty Lake than for Mud Bay. No attempt was made to define the enrichment status, owing to insufficient data, of lakes with less than six sets of measurements. These lakes are omitted from the following discussion, from Tables 2 and 3 and from Figure 2.

Table 2: Mean values for Secchi disc (meters) and chlorophyll a (micrograms per litre) data collected on six or more occasions from thirty-four lakes in the Southeastern Region during 1976.

LAKE		SECCHI DISC (meters)	CHLOROPHYLL a (ug/1)	NUMBER OF MEASUREMENTS
1.	Adams	4.1	3.4	10
4.	Big Rideau	4.1	2.3	12
5.	Black	4.2	1.4	11
6a)	Bobs - Buck Bay	4.8	2.6	11
b)	- Mud Bay	3.5	4.0	6
c)	- Western Basin	3.4	2.6	8
7.	Boulter	3.7	1.5	7
9.	Charleston			
a)	- Deep Water	3.8)	3.8)	6
b)	- Big Water	3.9)*	4.0)*	6
c)	- Donaldson Bay	4.3)	1.7)	6
d)	- Wesbster Bay	3.6)*	2.2)*	8
10.	Christie - 2	4.2)	3.5)	11
	- 7	4.7)*	3.2)*	4
11.	Clarendon - 1	4.1)	1.5)	3
	- 2	4.8)*	2.3)*	7
13.	Collins Bay	2.8	3.5	13
15.	Crowe	4.7	3.3	7
16.	Dalhousie	3.9	2.3	15
17.	Devil - A	5.2)	1.5)	11
	- B	5.3)*	1.6)*	11
	- C	5.4)	1.2)	8
	- D	4.9)	1.6)	9
20.	Glanmire	3.2	2.3	8
22.	Green	8.5	1.6	8
23.	Grippen	3.9	3.1	7
26.	Joe Perry	4.3	1.6	7

LAKE	SECCHI DISC (meters)	CHLOROPHYLL a (ug/l)	NUMBER OF MEASUREMENTS
28. Kennebec	4.1	2.7	7
30. Limerick	4.7	1.0	8
31. Loughborough			
a) - East Basin	3.4	2.1	14
b) - West Basin	4.5	2.5	7
32. Mackie	6.0	1.3	8
33. Mazinaw			
- Lower	5.7)	1.2)	16
- Upper	5.3)*	1.2)*	9
34. Mink	3.6	1.8	11
36. Ottawa River (near L'Orignal)	1.4	1.8	10
37. Otter - 1	3.1)	2.9)	10
- 2	3.3)*	1.2)*	4
38. Otty - A	4.5)	1.8)	18
- B	4.6)*	1.9)*	18
39. Pike	2.4	4.4	15
41. Upper Rideau	1.5	6.5	9
43. Salmon Trout	3.4	6.6	12
44. Sharbot			
- West Basin	4.1	2.0	10
46. St. Peter	3.6	1.9	7
47. Steenburg	4.3	1.3	7
48. Temperance	1.9	3.6	7
49. White - 1	2.0)	6.7)	14
- 2	2.3)*	7.1)*	13
- 3	2.7)	5.2)	12
50. White (Olden Twp.)	4.8	1.2	9

NOTE: Lakes with less than six sets of measurements are omitted due to the lack of sufficient data.

* Due to similarity between stations, values were averaged for inclusion in Table 3 and in the graph of Figure 2.

Mean Secchi disc depths in lakes, that were sampled on six or more occasions, were lowest in the Ottawa River near L'Orignal (1.4 metres*) and Upper Rideau Lake (1.5 metres). The most transparent waters were Green Lake (8.5 metres), Mackie Lake (6.0 metres) and Mazinaw Lake (5.5 metres). Lakes with a mean Secchi disc reading exceeding 5 metres have little biological enrichment and are termed oligotrophic. Oligotrophic lakes have a low nutrient supply in relation to their volume and are almost invariably large deep basins. Secchi disc readings between 3 metres and 5 metres typify most of our lakes and are indicative of a moderate amount of enrichment. These lakes are termed mesotrophic and are generally mid-sized basins with maximum depths under 50 feet. Lakes with Secchi readings less than 3 metres are eutrophic and are exhibiting an attentuation of light transmission due in part to high concentration of algae suspended in their waters.

In general, chlorophyll concentrations were low; the highest mean values, for lakes with 6 or more sets of measurements, were found in Salmon Trout Lake (6.6 ug/l), Upper Rideau Lake (6.5 ug/l) and White Lake (6.3 ug/l). High individual chlorophyll levels were also periodically observed in Buck Bay and Mud Bay of Bobs Lake, Deep Water and Big Water of Charleston Lake,

* Multiply metres by 3.28 to obtain feet.

Christie Lake, Limerick Lake, Otter Lake, Pike Lake, and Temperance Lake and may have occurred in other lakes. The high concentrations of chlorophyll on August 22 and September 13 in Temperance Lake were probably due to accidential contamination of the water samples by bottom sediment. Consequently those measurements were excluded in determination of the seasonal mean chlorophyll concentration of Temperance Lake (Table 2). Concentrations between 0 and 2 ug/l indicate low levels of algae. Concentrations between 2 and 5 ug/l, although moderately high, may be considered acceptable for most water-oriented recreational pursuits. Levels exceeding 5 ug/l on a seasonal average reflect high algal densities. At these higher levels, deterioration of water quality for activities such as swimming or water-skiing may be expected, as well as a reduction in the aesthetic quality of the lake.

As pointed out earlier, Secchi disc readings indicate the depth to which light penetrates into a lake and chlorophyll is a photosynthetic green pigment in algae. Since light penetration is affected by the amount of algae suspended in the water, a good correlation has been found to exist between Secchi disc readings and the amount of chlorophyll in a series of lakes of

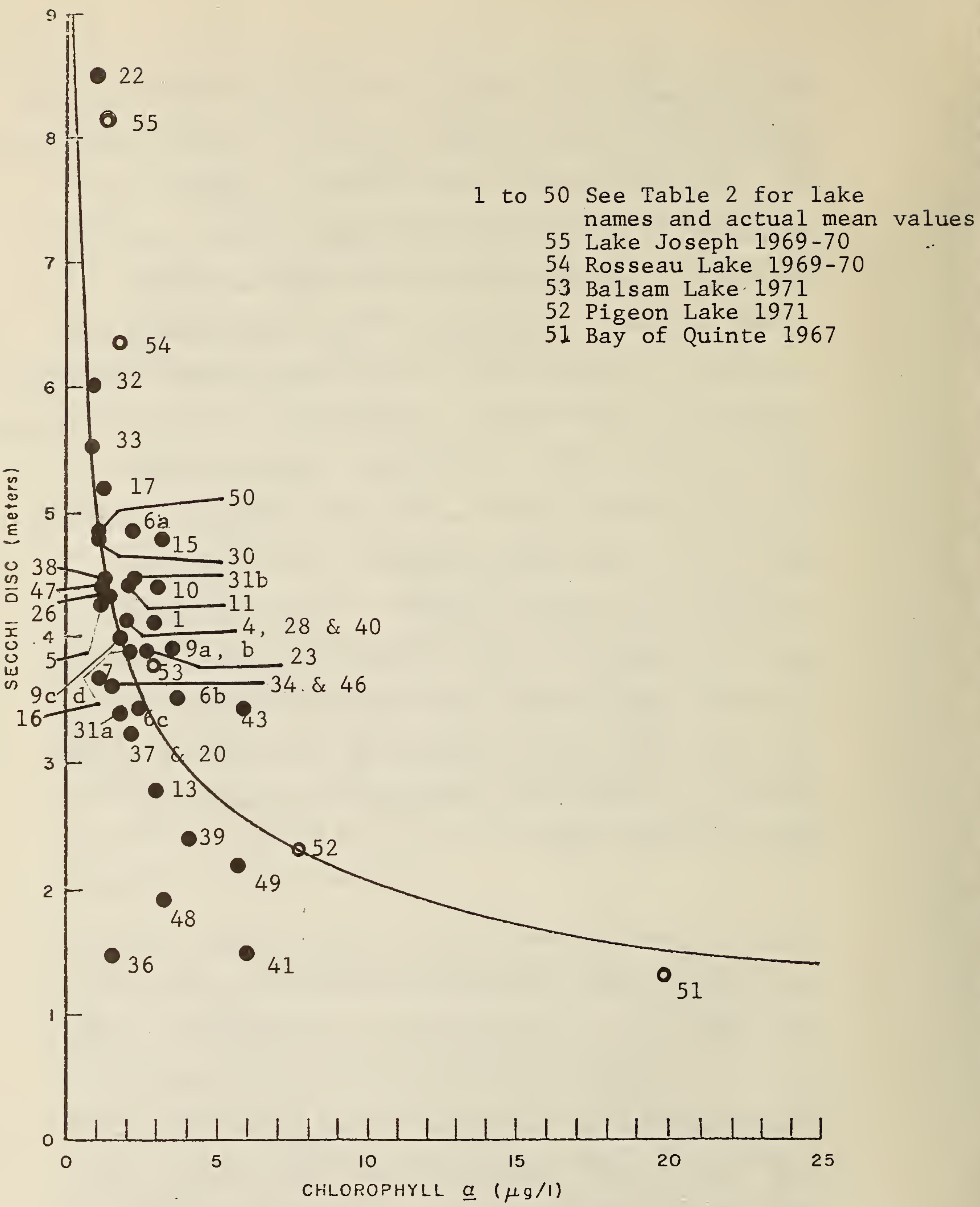


FIGURE 2: The relationship between Secchi disc and chlorophyll a for thirty-four lakes in the Southeastern Region of Ontario. Values for all lakes are based on means of measurements obtained during the summer of 1976. Also, information from a number of other lakes is also included as an indication of the relative enrichment status of lakes in the study area.

varying degrees of enrichment. The curve in Figure 2 depicts this relationship for a large number of data sets collected from many lakes in the Province.

Oligotrophic lakes, which allow significant light penetration and have low chlorophyll levels, lie on the vertical arm of the curve in the upper left of the graph, while points for eutrophic or highly enriched lakes, characterized by poor water clarity and high chlorophyll concentrations, are situated along the horizontal arm in the lower right area of the graph. Data for mesotrophic or moderately productive lakes are dispersed about the middle section of the curve.

Green Lake is situated near Lake Joseph; and Mackie, Mazinaw and Devil Lakes are situated near Rosseau Lake; two oligotrophic lakes in the Muskoka Lakes area of Ontario. The majority of lakes included in this year's program were clustered about the intermediate section of the curve, near Balsam Lake, a moderately enriched lake in the Kawartha Lakes area. Pike, White, Temperance and Upper Rideau Lakes are closer to Pigeon Lake, an enriched lake in the Kawarthas. All 34 lakes, with six or more sets of measurements, were well removed from the highly enriched waters in the Bay of Quinte.

Salmon Trout, Temperance, and Upper Rideau Lakes and the Ottawa River are positioned somewhat removed from the established curve. Salmon Trout Lake maintains a good water clarity, 3.4 metres visibility as measured by the Secchi disc, in spite of a relatively high standing crop of algae, as evidenced by a mean chlorophyll concentration of 6.6 ug/l. On the other hand, the Ottawa River, White Lake and Upper Rideau Lake experience less water clarity than would be expected on the basis of their summer mean chlorophyll levels alone. The Ottawa River contains coloured water which reduces its water clarity while Temperance Lake, owing to its shallow nature, may suffer reduced clarity due to wind induced turbidity. There is no apparent explanation for the deviation of Upper Rideau Lake from the established curve. However, since Upper Rideau Lake is a very productive basin, it is likely subject to wide fluctuations in both water clarity and algal densities. Over the longer term, it might be expected that the mean values for Secchi disc and chlorophyll would eventually place Upper Rideau Lake closer to the established curve in Figure 2.

Some lakes have now been sampled for a number of consecutive years (see Table 3). In most cases, annual variations in Secchi disc readings and/or chlorophyll concentrations are minor and can be attributed to the year to year variations in sunlight, rainfall, flushing and nutrient levels within the watershed of each lake.

Table 3: Mean values for Secchi disc (meters) and chlorophyll a (micrograms per litre) data for lakes in the Southeastern Region for which two or more years of data are available.

LAKE	1976*		1975		1974		1973		1972	
	S.D.	Chl. a	S.D.	Chl. a	S.D.	Chl. a	S.D.	Chl. a	S.D.	Chl. a
Baptiste - 1			3.2	2.1	3.4	0.4				
Big Rideau	4.1	2.3	4.5	1.5						
Bobs										
- Buck Bay	4.7	2.6								
- Mud Bay	3.5	4.0								
- Western Basin	3.4	2.6								
- Eastern Basin			5.4	2.4						
Collins Bay	2.8	3.5	2.8	4.2						
Crowe	4.7	3.3	4.7	2.7	4.7	1.2			3.8	1.7
Devil	5.2	1.5	5.1	1.9	5.7	1.5				
Glanmire	3.2	2.3	3.6	6.3						
Grippen	3.9	3.1	2.9	2.6						
Limerick	4.7	1.1	5.0	1.1						
Loughorough										
- East	3.4	2.1	2.3	4.9	2.7	2.6	3.3	3.3		
- West	4.5	2.5	4.1	2.1	3.8	2.0	4.0	1.2		

LAKE	1976*		1975		1974		1973		1972	
	S.D.	Chl. a	S.D.	Chl. a	S.D.	Chl. a	S.D.	Chl. a	S.D.	Chl. a
Mazinaw	5.4	1.2	5.6	1.0						
Mink	3.6	1.8	3.8	1.8						
Otter	3.2	2.1	3.2	1.4						
Otty	4.6	1.8	4.5	1.8	3.8	1.0	4.1	1.9		
Salmon Trout	3.4	6.6	3.0	7.9	3.7	1.4				
White	2.3	6.3	3.1	3.9	3.0	2.2	2.6	4.4	1.8	4.8
White (Olden Twp.)	4.8	1.2	4.9	1.3						

*NOTE: Lakes with less than six sets of measurements are omitted due to the lack of sufficient data.

A considerable decrease in chlorophyll content and a corresponding increase in water clarity was evident in the East Basin of Loughborough Lake from 1975 to 1976 and this change was accompanied by an observation of less rooted and floating aquatic vegetation. White Lake, in Renfrew and Lanark Counties, which exhibited consistent increases in Secchi disc readings between 1972 and 1975, showed a decrease in Secchi disc depth and an increase in chlorophyll concentration in 1976. However, in view of the longer term data, these levels may be within the range of year to year variations in water clarity and algal densities of each lake.

A more realistic assessment of the enrichment status was available for Glanmire Lake in 1976 than in 1975 based on an increase in the duration and frequency of sampling of Glanmire Lake in 1976. Salmon Trout and Crowe Lakes were also sampled more frequently in 1976 than in 1975, and consequently more confidence can be placed in the evaluation of their enrichment status as well. The continued high concentrations of chlorophyll in Salmon Trout Lake in 1976 compared to the relatively low value measured in 1974 warrants further investigation. Salmon Trout Lake will be considered for inclusion in the 1977 lake survey program of the Ministry of Environment.

RECOMMENDATIONS

In view of the annual variations in Secchi disc readings and chlorophyll concentrations, sampling is required for a number of years to define long term trends. It is hoped that participants will consider a continuation of their program so that the Ministry of the Environment will have a record of water quality on their lake and be alerted to any deterioration should it occur so that possible remedial action can be taken. Ideally, sampling should be conducted on a weekly basis during the ice-free period of the year.

Owing to a large number of lakes that have not been sampled, additional participation in the program is encouraged. For information and assistance in establishing a Self-Help Program, write to: Self-Help Program, Ontario Ministry of the Environment, P.O. Box 820, 133 Dalton Street, Kingston, Ontario K7L 4X6. Telephone 549-4000.

Table 4: Secchi disc (meters) and chlorophyll a (mircrograms per litre) data collected from fifty lakes in the Southeastern Region during the summer of 1976. Mean values are also presented.

LAKE		DATE	SECCHI DISC (m)	CHLOROPHYLL a (ug/1)
1.	Adams	July 4	3.2	2.6
		18	4.0	4.4
		25	4.7	3.2
		Aug. 2	3.4	2.6
		29	4.9	4.2
		Sept.		
		5	4.1	3.4
		12	4.4	5.1
		29	4.6	4.5
		Oct. 3	4.3	2.2
		11	3.5	1.6
		MEAN	4.1	3.4
2a.	Baptiste			
	Stn. 1	July 22	3.1	2.6
		Aug. 2	3.0	1.8
		MEAN	3.1	2.2
	Stn. 2	July 22	3.7	2.3
		Aug. 2	3.1	1.6
		MEAN	3.4	2.0
3.	Beaver			
	- South			
	Beaver	July 4	3.4	4.9
		11	2.3	5.2
		19	3.3	5.0
		MEAN	3.0	5.0
4.	Big			
	Rideau	July 4	4.7	2.3
		18	4.3	2.7
		25	4.9	1.9
		25	3.8	0.6
		Aug. 1	2.6	1.9
		2	4.3	3.1
		14	2.6	0.8
		Sept.		
		5	3.7	3.7
		12	3.8	4.1
		9	3.8	3.0
		Oct. 3	4.6	2.2
		11	5.8	1.2
		MEAN	4.1	2.3

LAKE		DATE	SECCHI DISC (m)	CHLOROPHYLL a (ug/1)
5.	Black	June 30	3.1	1.6
		July 7	3.7	2.1
		15	3.7	1.6
		21	4.3	1.3
		28	4.3	1.8
		Aug. 11	4.0	0.9
		18	4.3	2.1
		18	4.3	1.2
		25	4.6	1.3
		Sept. 1	4.3	1.2
		8	5.2	0.8
		MEAN	4.2	1.4
6.	Bobs - Buck Bay	May 30	5.0	1.6
		June 20	5.2	2.2
		26	5.0	1.1
		July 4	6.3	2.2
		Sept. 19	4.1	2.5
		Oct. 3	3.4	6.3
		MEAN	4.8	2.6
	- Mud Bay	July 4	3.4	2.4
		11	3.4	1.2
		18	3.2	4.0
		Aug. 15	3.2	7.6
		22	4.6	5.4
		Sept. 5	2.9	3.4
		MEAN	3.5	4.0
	- Western Basin	July 14	3.2	2.6
		21	3.5	3.8
		26	3.4	3.2
		Aug. 4	3.2	2.5
		11	3.5	2.7
		18	3.2	3.8
		25	3.4	1.8
		Sept. 1	3.4	0.7
		MEAN	3.4	2.6

LAKE		DATE	SECCHI DISC (m)	CHLOROPHYLL a (ug/l)
7.	Boulter	Aug. 4	3.7	1.0
		17	3.7	1.5
		Sept.		
		6	3.7	1.8
		12	3.7	1.0
		19	3.7	1.5
		26	3.7	1.9
		Oct. 3	3.7	2.0
		MEAN	3.7	1.5
8.	Buck	June 27	4.1	2.3
		July 4	4.4	2.9
		Aug. 8	2.3	3.6
		15	2.3	4.3
		22	2.7	4.6
		MEAN	3.2	3.5
9.	Charleston			
	- Deep Water	June 14	3.2	2.8
		28	4.6	2.2
		July 5	3.7	6.7
		18	3.7	5.0
		28	4.1	1.5
		Aug. 3	3.4	4.8
		MEAN	3.8	3.8
	- Big Water	June 14	3.8	2.7
		28	4.1	2.6
		July 5	4.0	7.9
		18	3.7	4.7
		28	4.1	2.3
		Aug. 3	3.7	3.6
		MEAN	3.9	4.0
	- Donaldson Bay	June 27	5.0	2.1
		July 22	4.0	3.5
		Aug. 4	3.7	1.2
		11	4.0	1.1
		17	4.1	1.1
		26	5.0	1.4
		MEAN	4.3	1.7

LAKE		DATE	SECCHI DISC (m)	CHLOROPHYLL a (ug/l)
9.	Charleston - Webster Bay	June 27	5.0	1.3
		July 4	3.5	4.4
		12	2.9	2.2
		18	3.1	1.6
		27	2.9	2.2
		Aug. 1	3.5	4.4
		9	4.4	2.0
		15	3.2	1.4
		MEAN	3.6	2.2
10.	Christie Stn. 2	June 4	6.4	1.2
		11	5.5	1.0
		18	5.6	1.8
		Aug. 8	3.8	2.5
		15	4.3	6.8
		22	4.4	1.9
		29	4.1	3.0
		Sept. 6	3.7	6.0
		12	3.1	6.9
		Oct. 3	2.7	4.7
		24	2.6	1.1
		MEAN	4.2	3.5
	Stn. 7	June 20	6.1	1.9
		27	6.6	1.0
		Aug. 29	3.8	3.9
		Oct. 3	2.3	5.8
		MEAN	4.7	3.2
	Stn. 8	June 20	6.0	1.7
		27	5.5	1.5
		MEAN	5.8	1.6
	Stn. 3	June 20	6.0	2.0
		27	6.1	1.5
		MEAN	6.1	1.8

LAKE		DATE	SECCHI DISC (m)	CHLOROPHYLL a (ug/l)
10.	Christie			
	Stn. 9	July 4	6.4	1.4
	Stn. 10	July 4	6.7	1.4
11.	Clarendon			
	Stn. 1	June 13	4.4	1.4
		20	4.6	1.0
		Aug. 8	3.4	2.1
		MEAN	4.1	1.5
	Stn. 2	June 6	4.0	1.6
		July 11	4.1	3.5
		25	4.0	2.4
		Aug. 22	4.3	2.8
		29	4.9	1.6
		Sept. 12	6.3	2.4
		19	6.0	2.1
		MEAN	4.8	2.3
12.	Clear	June 24	6.9	0.7
		July 4	5.6	1.6
		Aug. 2	3.7	1.9
		Sept. 26	7.0	1.5
		MEAN	5.8	1.4
13.	Collins Bay	May 30	2.9	2.9
		June 7	2.8	2.5
		20	2.3	2.7
		27	1.7	2.4
		July 11	2.0	4.2
		25	3.5	2.3
		11	2.9	4.8
		18	3.2	3.9
		24	3.2	3.9
		29	2.0	3.5
		Sept. 12	3.2	2.9
		19	3.5	4.5
		Oct. 17	3.2	4.7
		MEAN	2.8	3.5

LAKE		DATE	SECCHI DISC (m)	CHLOROPHYLL a (ug/l)
14.	Coulonge	Aug. 2	2.4	3.4
		Sept. 6	2.7	2.0
		Oct. 11	2.4	1.2
		MEAN	2.5	2.2
15.	Crowe	Aug. 14	4.6	3.8
		22	5.2	3.8
		29	4.6	2.0
		Sept. 6	4.9	3.9
		12	4.9	2.0
		19	5.2	3.6
		30	3.7	4.1
		MEAN	4.7	3.3
16.	Dalhousie			
		June 13	3.2	0.7
		20	4.1	0.6
		27	4.3	1.0
		July 4	5.0	1.3
		4	5.3	1.8
		11	5.0	2.1
		11	4.9	1.9
		18	3.8	2.0
		19	3.7	2.5
		25	3.4	2.8
		Aug. 2	3.5	3.5
		8	2.9	1.9
		15	3.8	4.8
		22	3.5	4.7
		Oct. 3	1.7	3.2
		MEAN	3.9	2.3
17.	Devil			
	Stn. A	July 7	6.0	2.6
		8	5.6	2.0
		25	6.1	1.9
		Aug. 2	5.5	1.6
		8	4.6	0.2
		8	4.6	0.1
		22	6.3	1.7
		29	5.3	1.2
		Sept.		
		19	4.5	2.0
		Oct. 3	4.3	1.0
		17	4.3	1.8
		MEAN	5.2	1.5

LAKE		DATE	SECCHI DISC (m)	CHLOROPHYLL a (ug/l)
17.	Devil			
	Stn. B	July 7	5.5	2.2
		18	6.0	2.1
		25	5.6	1.9
		Aug. 2	5.3	1.8
		8	4.6	0.6
		22	6.4	1.9
		29	5.2	1.1
		Sept. 6	5.0	2.0
		19	4.6	1.7
		Oct. 3	4.7	0.9
		17	5.3	1.8
		MEAN	5.3	1.6
	Stn. C	July 25	5.8	1.4
		Aug. 2	6.0	1.6
		8	4.7	0.3
		8	4.7	0.1
		22	6.6	1.4
		Sept. 19	4.7	1.9
		Oct. 3	5.7	0.9
		17	4.7	2.0
		MEAN	5.4	1.2
	Stn. D	July 25	5.2	1.8
		Aug. 2	4.9	1.8
		8	4.4	2.7
		8	4.4	0.4
		22	5.8	0.2
		Sept. 6	4.9	2.1
		19	4.4	1.9
		Oct. 3	5.3	0.9
		17	4.9	2.2
		MEAN	4.9	1.6
18.	Dropledge			
		June 13	4.9	1.7
		July 19	4.7	1.2
		Sept. 26	6.4	1.4
		MEAN	5.3	1.4

LAKE		DATE	SECCHI DISC (m)	CHLOROPHYLL a (ug/l)
19.	Garvin	July 4	4.6	1.6
20.	Glanmire	June 6	3.1	0.8
		20	4.9	0.4
		27	4.9	--
		July 4	4.9	--
		11	4.0	--
		18	4.3	--
		25	4.3	--
		Aug. 2	3.4	--
		22	4.0	1.1
		29	3.4	0.6
		Sept. 12	3.1	1.3
		Oct. 4	2.1	2.7
		11	1.8	7.5
		Nov. 7	3.1	4.0
		MEAN	3.7	2.3
21.	Golden	Aug. 2	3.8	2.5
		12	3.5	1.8
		MEAN	3.7	2.2
22.	Green	June 13	7.0	3.0
		20	7.9	0.7
		27	9.3	0.7
		July 4	10.5	1.0
		11	8.2	0.7
		Aug. 15	8.1	3.8
		22	9.5	1.0
		29	7.6	2.2
		MEAN	8.5	1.6
23.	Grippen	July 4	4.9	3.3
		11	4.9	2.9
		18	3.4	3.2
		25	3.4	2.3
		Aug. 22	3.7	5.6
		29	2.3	3.2
		Sept. 6	4.4	1.1
		MEAN	3.9	3.1

LAKE		DATE	SECCHI DISC (m)	CHLOROPHYLL a (ug/l)
24.	Hay Bay	Aug. 23	0.8	14.0
		30	0.8	17.0
		Sept.		
		14	0.8	10.0
		30	0.8	23.0
		Oct. 26	0.8	1.4*
		MEAN	0.8	16.0
25.	Little Silver	Aug. 1	3.7	1.7
26.	Joe Perry			
		July 8	3.7	1.9
		14	3.4	2.2
		23	4.9	1.3
		29	3.4	1.3
		Aug. 10	4.9	--
		24	5.2	1.4
		Sept. 7	4.3	1.3
		MEAN	4.3	1.6
27.	Kamaniskeg			
	Stn. 1	June 29	4.9	1.0
		July 27	5.2	1.0
		Aug. 24	4.3	1.4
		Oct. 18	3.7	1.3
		MEAN	4.5	1.2
	Stn. 2	June 29	5.0	1.1
		July 27	4.6	1.2
		Aug. 24	4.3	1.5
		Oct. 18	3.7	27.5*
		MEAN	4.4	1.3
28.	Kennebec	Aug. 22	3.9	4.2
		29	4.4	1.4
		Sept. 6	4.8	1.2
		9	4.5	1.7
		19	4.3	2.8
		Oct. 3	3.2	4.7
		11	3.7	2.7
		MEAN	4.1	2.7

LAKE		DATE	SECCHI DISC (m)	CHLOROPHYLL a (ug/l)
29.	Leatheroot			
		June 17	3.5	0.6
30.	Limerick	Aug. 13	4.0	0.8
		19	4.7	1.2
		27	4.6	0.9
		Sept. 8	5.2	1.0
		Oct. 8	5.5	14.8*
		13	5.2	1.5
		MEAN	4.7	1.0
31.	Loughborough - East Basin	June 25	3.5	1.9
		July 4	3.4	1.5
		13	3.2	1.6
		20	3.0	2.9
		27	3.1	2.8
		Aug. 3	2.6	3.6
		11	2.3	1.0
		25	2.6	2.0
		Sept. 6	3.5	1.0
		12	6.6	1.3
		14	3.7	2.0
		22	3.7	1.7
		Oct. 6	3.5	1.9
		13	3.4	3.6
		MEAN	3.4	2.1
	- West Basin	Aug. 15	4.4	2.6
		22	4.4	1.8
		29	4.3	2.3
		Sept. 6	4.6	3.0
		12	4.6	2.3
		19	5.2	2.3
		30	3.8	3.1
		MEAN	4.5	2.5
32.	Mackie	June 12	5.6	1.7
		July 4	6.7	2.6
		11	6.6	1.0
		18	6.6	1.1
		25	6.0	1.1
		Aug. 8	5.0	0.6
		15	5.2	1.0
		Sept. 12	6.6	1.3
		MEAN	6.0	1.3

LAKE		DATE		SECCHI DISC (m)	CHLOROPHYLL *a* (ug/l)
33.	Mazinaw - Lower	June	20	5.5	0.9
			27	5.5	1.5
		July	12	5.5	1.6
			12	--	1.4
			19	5.8	1.2
			25	5.8	0.7
		Aug.	2	5.2	1.0
			9	5.8	0.9
			16	4.9	1.1
			24	6.1	0.4
			30	6.1	1.3
		Sept.	6	5.5	1.2
			12	5.8	1.4
			19	5.8	2.0
			26	5.8	1.7
		Oct.	3	6.4	1.5
			10	6.1	1.0
		MEAN		5.7	1.2
	- Upper	June	14	4.9	1.3
			23	5.5	0.7
		July	5	6.7	1.5
			8	4.9	1.3
			14	4.3	1.3
			27	4.6	0.7
		Aug.	10	4.9	1.1
			24	5.2	1.6
		Sept.	7	6.7	1.3
		MEAN		5.3	1.2
34.	Mink	June	14	4.9	0.8
			21	4.8	1.3
		July	12	4.4	2.7
			25	3.8	1.3
		Aug.	24	2.9	1.6
			31	2.6	2.0
		Sept.	7	2.7	0.9
			13	3.2	--
			27	3.4	2.8
		Oct.	4	3.5	2.0
			11	3.0	2.6
		MEAN		3.6	1.8

LAKE		DATE	SECCHI DISC (m)	CHLOROPHYLL *a* (ug/1)
35.	O'Brien	July 4	7. 0	3.7
36.	Ottawa River	July 5	1.1	2.6
		13	1.1	2.1
		19	1.1	1.2
		27	1.1	4.2
		Aug. 2	1.4	2.0
		10	1.4	0.6
		17	1.4	1.1
		24	1.7	2.3
		31	1.7	1.3
		Sept. 7	1.7	0.8
		MEAN	1.4	1.8
37.	Otter Stn. 1	July 5	3.1	4.3
		14	3.1	1.4
		19	2.7	6.6
		Aug. 6	3.1	1.3
		10	3.7	2.0
		25	2.7	0.6
		Sept. 2	3.1	1.6
		8	3.4	--
		19	2.9	5.1
		Oct. 3	3.1	3.4
		MEAN	3.1	2.9
	Stn. 2	July 28	3.8	1.8
		Aug. 4	3.4	1.7
		11	3.4	1.5
		Sept. 3	2.4	1.2
		MEAN	3.3	1.2

LAKE	DATE	SECCHI DISC (m)	CHLOROPHYLL a (ug/l)
38. Otty			
Stn. A	May 23	3.3	--
	30	3.5	2.2
	June 6	4.0	0.8
	13	4.3	0.9
	20	4.8	1.4
	27	4.5	1.6
	July 4	5.8	1.3
	11	4.0	1.7
	18	3.8	3.1
	25	3.5	2.6
	Aug. 8	4.0	1.4
	15	4.0	2.2
	22	4.4	1.4
	29	6.4	1.1
	Sept.		
	6	5.0	1.2
	12	6.3	1.8
	19	4.0	2.3
	26	4.9	2.4
	Oct. 3	4.5	2.4
	MEAN	4.5	1.8
Stn. B	May 23	3.0	4.5
	June 6	4.3	0.9
	13	4.0	1.1
	20	5.3	0.9
	27	5.3	1.6
	July 4	5.3	1.6
	11	4.0	1.6
	18	3.8	3.2
	25	3.5	2.0
	Aug. 8	4.0	2.1
	15	4.3	2.5
	22	5.0	1.4
	29	5.9	1.0
	Sept.		
	6	4.8	1.5
	12	6.7	1.6
	19	4.3	2.2
	26	4.6	2.2
	Oct. 3	4.8	2.3
	MEAN	4.6	1.9

LAKE		DATE	SECCHI DISC (m)	CHLOROPHYLL a (ug/l)
39.	Pike	June 9	2.1	1.9
		21	2.1	3.0
		27	2.4	0.5
		July 4	2.7	3.7
		5	2.7	3.4
		11	2.9	3.6
		15	2.6	2.4
		18	2.3	3.2
		25	2.1	4.3
		25	2.6	4.4
		Aug. 2	2.4	6.0
		9	2.1	6.3
		22	2.6	8.0
		29	2.0	7.1
		Sept. 12	2.7	7.9
		MEAN	2.4	4.4
40.	Presqu'ile Bay	July 14	Surface sample	3.2
		Aug. 15	2.3	0.7
		MEAN	1.1	2.0
41.	Upper Rideau	June 1	1.3	8.8
		7	1.2	5.7
		15	1.3	3.8
		24	1.3	7.3
		July 4	1.1	6.2
		7	1.3	15.0
		19	1.5	1.1
		Aug. 11	2.1	7.5
		23	2.1	2.7
		MEAN	1.5	6.5
42.	Round	Aug. 11	3.7	1.3
		24	4.9	1.7
		Sept. 9	3.2	2.8
		Oct. 3	2.1	1.4
		MEAN	3.5	1.8

LAKE		DATE	SECCHI DISC (m)	CHLOROPHYLL a (ug/1)
43.	Salmon Trout	June 27	5.2	10.0
		July 4	4.3	4.7
		11	4.3	10.0
		18	3.1	9.1
		24	2.3	5.6
		Aug. 2	2.2	10.0
		8	2.4	6.8
		22	3.5	4.4
		29	3.7	4.3
		Sept. 6	2.7	6.9
		12	3.4	4.1
		30	3.2	3.3
		MEAN	3.4	6.6
44.	Sharbot - West Basin	June 31	3.4	1.7
		July 7	3.4	1.7
		15	4.3	3.6
		21	4.0	2.3
		28	4.0	2.2
		Aug. 11	4.0	1.7
		18	4.6	2.0
		25	4.3	2.0
		Sept. 1	4.3	1.5
		8	4.6	1.6
		MEAN	4.1	2.0
45.	Shavings	June 6	5.6	1.0
		July 14	5.6	0.4
		MEAN	5.6	0.7
46	St. Peter	Aug. 4	3.7	0.9
		21	3.7	1.4
		Sept.		
		6	3.7	2.5
		12	3.4	2.4
		19	2.6	2.9
		26	3.7	1.3
		Oct. 3	4.6	1.6
		MEAN	3.6	1.9

LAKE		DATE	SECCHI DISC (m)	CHLOROPHYLL a (ug/1)
47.	Steenburg			
		June 6	5.5	1.4
		13	4.0	1.0
		27	3.2	0.7
		July		
		16	4.6	1.2
		Aug. 2	4.9	1.9
		15	4.0	1.3
		Sept.		
		2	4.3	1.9
		14	4.3	1.7
		Oct. 6	4.3	0.9
		MEAN	4.3	1.3
48.	Temperance			
		Aug. 22	1.6	19.0*
		29	2.0	0.7
		Sept. 6	2.4	2.1
		13	1.8	17.0*
		19	2.1	3.3
		25	1.8	8.2
		Oct. 3	1.9	3.5
		MEAN	1.9	3.6
49.	White (Renfrew & Lanark Counties)			
	Stn. 1	May 24	2.1	3.1
		30	3.2	--
		June 6	2.4	2.9
		13	--	5.0
		20	2.3	2.7
		27	2.3	3.5
		July 4	2.3	2.2
		11	1.8	3.4
		18	1.7	2.5
		25	1.5	8.0
		Aug. 2	1.5	9.6
		15	3.1	8.5
		22	1.9	6.9
		Sept.		
		6	1.4	5.7
		12	1.5	11.0
		19	1.1	26.0
		MEAN	2.0	6.7

LAKE		DATE	SECCHI DISC (m)	CHLOROPHYLL a (ug/1)
49.	White			
	Stn. 2	May 24	2.4	2.8
		30	2.7	--
		June 6	3.7	3.2
		13	--	3.8
		20	2.4	3.0
		27	2.9	2.9
		July 4	4.4	2.0
		11	2.6	2.1
		18	2.1	5.3
		25	1.5	7.9
		Aug. 2	1.7	9.9
		15	3.1	5.3
		22	1.5	8.6
		Sept.		
		6	1.5	--
		12	1.4	12.0
		19	1.1	24.0
		MEAN	2.3	7.1
	Stn. 3	Apr. 24	3.1	--
		May 1	2.7	--
		9	2.9	--
		15	2.7	--
		24	3.7	--
		24	1.8	2.9
		30	4.0	--
		30	3.2	--
		June 6	4.2	--
		6	4.0	--
		13	4.0	--
		20	3.1	--
		20	1.8	2.8
		27	3.1	--
		27	2.3	3.2
		July 4	2.1	--
		5	3.5	--
		11	3.1	--
		11	2.1	3.4
		18	2.1	6.2
		25	1.8	8.7
		Aug. 2	1.8	7.3
		15	3.1	1.1
		22	1.7	6.6
		28	1.9	--
		Sept. 5	1.9	--
		12	1.8	--
		12	1.5	6.4
		19	1.5	12.0
		26	1.9	--
		Oct. 11	2.4	--
		17	3.4	--
		23	3.1	--
		Nov. 7	3.7	--
		MEAN	2.7	5.2

LAKE	DATE	SECCHI DISC (m)	CHLOROPHYLL a (ug/1)
49. White Stn. 4	Apr. 24	2.7	
	May 1	2.7	
	9	2.7	
	15	2.9	
	24	3.4	
	30	3.9	
	June 6	4.0	
	13	4.0	
	20	3.2	
	27	3.4	
	July 5	3.7	
	11	4.0	
	Aug. 28	2.1	
	Sept. 5	1.9	
	12	2.1	
	26	1.7	
	Oct. 11	2.4	
	17	3.7	
	Nov. 7	4.0	
	MEAN	3.1	
50. White (Olden Twp.)	June 20	5.2	0.9
	July 4	5.0	1.3
	11	5.2	0.8
	25	5.0	1.8
	Aug. 2	4.3	1.5
	15	4.4	1.8
	22	5.5	2.2
	Sept. 6	4.3	0.8
	19	4.6	1.3
	MEAN	4.8	1.2

* Anomalous data excluded from determination of the mean.

APPENDIX A

INFORMATION OF GENERAL INTEREST TO COTTAGERS

MICROBIOLOGY OF WATER

For the sake of simplicity, the micro-organisms in water can be divided into two groups; the bacteria that thrive in the lake environment and make up the natural bacterial flora; and the disease causing microorganisms, called pathogens, that have acquired the capacity to infect human tissues.

The "pathogens" are generally introduced to the aquatic environment by raw or inadequately treated sewage, although a few are found naturally in the soil. The presence of these bacteria does not change the appearance of the water but poses an immediate public health hazard if the water is used for drinking or swimming. The health hazard does not necessarily mean that the water user will contract serious waterborn infections such as typhoid fever, polio or hepatitis, but he may catch less serious infections of gastroenteritis (sometimes called stomach flu), dysentery or diarrhea. Included in these minor afflictions are eye, ear and throat infections that swimmers encounter every year and the more insidious but seldom diagnosed, subclinical infections usually associated with several water born viruses. These viral infections leave a person not feeling well enough to enjoy holidaying although not bedridden. This type of microbial pollution can be remedied by preventing wastes from reaching the lake and water quality will return to satifactory conditions within a relatively short time (approximately 1 year) since disease causing bacteria usually do not thrive in an aquatic environment.

The rest of the bacteria live and thrive within the lake environment. These organisms are the instruments of biodegradation. Any organic matter in the lake will be used as food by these organisms and will give rise in turn to subsequent increases in their numbers. Natural organic matter as well as that from sewage, kitchen wastes, oil and gasoline are readily attacked by these lake bacteria. Unfortunately, biodegradation of the organic wastes by organisms uses correspondingly large amounts of the dissolved oxygen. If the organic matter content of the lake gets high enough, these bacteria will deplete the dissolved oxygen supply in the bottom waters and threaten the survival of many deep water fish species.

RAINFALL AND BACTERIA

The "Rainfall Effect" relates to a phenomenon that has been documented in previous surveys of recreational lakes. Heavy precipitation has been shown to flush the land area around the lake and the subsequent runoff will carry available contaminants including sewage organisms as well as natural soil bacteria with it into the water.

Total coliforms, fecal coliforms and fecal streptococci, as well as other bacteria and viruses which inhabit human waste disposal systems, can be washed into the lake. In Precambrian areas where there is inadequate soil cover and in fractured limestone areas where fissures in the rocks provide access to the lake, this phenomenon is particularly evident.

Melting snow provides the same transportation function for bacteria, especially in an agricultural area where manure spreading is carried out in the winter on top of the snow.

Previous data from sampling points situated 50 to 100 feet from shore indicate that contamination from shore generally shows up within 12 to 48 hours after a heavy rainfall.

WATER TREATMENT

Lake and river water is open to contamination by man, animals and birds (all of which can be carriers of disease); consequently, NO RIVER OR LAKE WATER MAY BE CONSIDERED SAFE FOR HUMAN CONSUMPTION without prior treatment, including disinfection. Disinfection is especially critical if coliforms have been shown to be present.

Disinfection can be achieved by:

(a) Boiling
Boil the water for a minimum of five minutes to destroy the disease causing organisms.

(b) Chlorination using a household bleach containing 4 to 5 1/4% available chlorine.
Eight drops of a household bleach solution should be mixed with one gallon of water and allowed to stand for 15 minutes before drinking.

(c) Continuous Chlorination

For continuous water disinfection, a small domestic hypochlorinator (sometimes coupled with activated charcoal filters) can be obtained from a local plumber or water equipment supplier.

(d) Well Water Treatment

Well water can be disinfected using a household bleach (assuming strength at 5% available chlorine) if the depth of water and diameter of the well are known.

CHLORINE BLEACH

Per 10 ft. Depth of Water

Diameter of Well Casing in Inches	One to Ten Coliforms	More than Ten Coliforms
4	.5 oz.	1 oz.
6	1 oz.	2 oz.
8	2 oz.	4 oz.
12	4 oz.	8 oz.
16	7 oz.	14 oz.
20	11 oz.	22 oz.
24	16 oz.	31 oz.
30	25 oz.	49 oz.
36	35 oz.	70 oz.

Allow about six hours of contact time before using the water.

Another bacteriological sample should be taken after one week of use.

Water Sources (spring, lake, well, etc.) should be inspected for possible contamination routes (surface soil, runoff following rain and seepage from domestic waste disposal sites). Attempts at disinfecting the water alone without removing the source of contamination will not supply bacteriologically safe water on a continuing basis.

There are several types of low cost filters (ceramic, paper, carbon, diatomaceous earth sometimes impregnated with silver, etc.) that can be easily installed on taps or in water lines. These may be useful in removing particles, if water is periodically turbid, and are usually very successful. Filters, however, do not disinfect water but may reduce bacterial numbers. For safety, chlorination of filtered water is recommended.

SEPTIC TANK INSTALLATIONS

In Ontario provincial law requires under Part 7 of the Environmental Protection Act that before you extend, alter, enlarge or establish any building where a sewage system will be used, a Certificate of Approval must be obtained from the Ministry of the Environment or its representatives. The local municipality or Health Unit may be delegated the authority to issue the Certificate of Approval. Any other pertinent information such as size, types and location of septic tanks and tile fields can also be obtained from the same authority.

(i) General Guidelines

A septic tank should not be closer than:

- 50 feet to any well, lake, stream, pond, spring, river or reservoir
- 5 feet to any building
- 10 feet to any property boundary

The tile field should not be closer than:

- 100 feet to the nearest dug well
- 50 feet to a drilled well which has a casing to 25 feet below ground
- 25 feet to a building with a basement that has a floor below the level of the tile in the tile bed
- 10 feet to any other building
- 10 feet to a property boundary
- 50 feet to any lake, stream, pond, spring, river or reservoir.

The ideal location for a tile field is in a well drained, sandy loam soil remote from any wells or other drinking water sources. For the tile field to work satisfactorily, there should be at least 3 feet of soil between the bottom of the weeping tile trenches and the top of the ground water table or bedrock.

DYE TESTING OF SEPTIC TANK SYSTEMS

There is considerable interest among cottage owners to dye test their sewage systems, however, several problems are associated with dye testing. Dye would not be visible to the eye from a system that has a fairly direct connection to the lake. Thus, if a cottager dye-tested his

system and no dye was visible in the lake, he would assume that his system is satisfactory, which might not be the case. A low concentration of dye is not visible and therefore expensive equipment such as a fluorometer is required. Only qualified people with adequate equipment are capable of assessing a sewage system by using dye. In any case, it is likely that some of the water from a septic tank will eventually reach the lake. The important question is whether all contaminants including nutrients have been removed before it reaches the lake. To answer this question special knowledge of the system, soil depth and composition, underground geology of the region and the shape and flow of the shifting water table are required. Therefore, we recommend that this type of study should be performed only by qualified professionals.

BOATING & MARINA REGULATIONS

In order to help protect the lakes and rivers of Ontario from pollution, it is required by law that sewage (including garbage) from all pleasure craft, including houseboats, must be retained in suitable equipment. Equipment which is considered suitable by the Ministry of the Environment includes (1) retention devices with or without re-circulation which retain all toilet wastes for disposal ashore, and (2) incinerating devices which reduce all sewage to ash.

Equipment for storage of toilet wastes shall:

1. be non-portable
2. be constructed of structurally sound material
3. have adequate capacity for expected use
4. be properly installed, and
5. be equipped with the necessary pipes and fittings conveniently located for pump-out by shore-based facilities (although not specified, a pump-out deck fitting with 1½-inch diameter National Pipe Thread is commonly used).

An Ontario regulation requires that marinas and yacht clubs provide or arrange pump-out service for the customers and members who have toilet-equipped boats. In addition, all marinas and yacht clubs must provide litter containers that can be conveniently used by occupants of pleasure boats.

The following "Tips" may be of assistance to you in boating:

1. Motors should be in good mechanical condition and properly tuned.
2. When a tank for outboard motor testing is used, the contents should not be emptied into the water.
3. If the bilge is cleaned, the waste material must not be dumped into the water.
4. Fuel tanks must not be overfilled and space must be left for expansion if the fuel warms up.
5. Vent pipes should not be obstructed and fuel needs to be dispensed at a correct rate to prevent "blow-back"
6. Empty oil cans must be deposited in a leak-proof receptacle, and
7. Slow down and save fuel.

ICE-ORIENTED RECREATIONAL ACTIVITIES

The Ministry of the Environment is presently preparing a regulation to prevent pollution from ice-oriented recreational activities.

Garbage or sewage left on the ice pollutes the lakes or rivers. The bottoms of ice shelters (ice-fishing huts) or other debris, if left on the ice, may become a hazard later on to boaters and water skiers or a litter problem on some cottager's beach. While bathing, summer vacationists have been badly cut by broken glass and other sharp objects reportedly left on the ice by winter anglers.

With the anticipated enforcement of the regulations, all of these offences will be subject to stricter control.

EUTROPHICATION OR EXCESSIVE FERTILIZATION AND LAKE PROCESSES

In recent years, cottagers have become aware of the problems associated with nutrient enrichment of recreational lakes and have learned to recognize many of the symptoms characterizing nutrient enriched (eutrophic) lakes. It is important to realize that small to moderate amounts of aquatic plants and algae are necessary to maintain a balanced aquatic environment. They provide food and a suitable environment for the growth of aquatic invertebrate organisms which serve as food for fish. Shade from large aquatic plants helps to keep the lower water cool, which is essential to certain species of fish and also provides protection for young game and forage fish. Numerous aquatic plants are utilized for food and/or protection by many species of waterfowl. However, too much growth creates an imbalance in the natural plant and animal community particularly with respect to oxygen conditions, and some desirable forms of life such as sport fish are eliminated and unsightly algae scums can form. The lake will not be "dead" but rather abound with life which unfortunately is not considered aesthetically pleasing. This change to poor water quality becomes apparent after a period of years during which extra nutrients are added to the lake and return to the natural state may also take a number of years after the nutrient inputs are stopped.

Changes in water quality with depth are a very important characteristic of a lake. Water temperatures are uniform throughout the lake in the early spring and winds generally keep the entire volume well mixed. Shallow lakes may remain well mixed all summer so that water quality will be the same throughout. On the other hand, in deep lakes, the surface waters warm up during late spring and early summer and float on the cooler more dense water below. The difference in density offers a resistance to mixing by wind action and many lakes do not become fully mixed again until the surface waters cool down in the fall. The bottom water received no oxygen from the atmosphere during this unmixed period and the dissolved oxygen supply may be all used up by bacteria as they decompose organic matter. Cold water fish, such as trout, will have to move to the warm surface waters to get oxygen and because of the high water temperatures they will not thrive, so that the species will probably die out (see Figure next page).

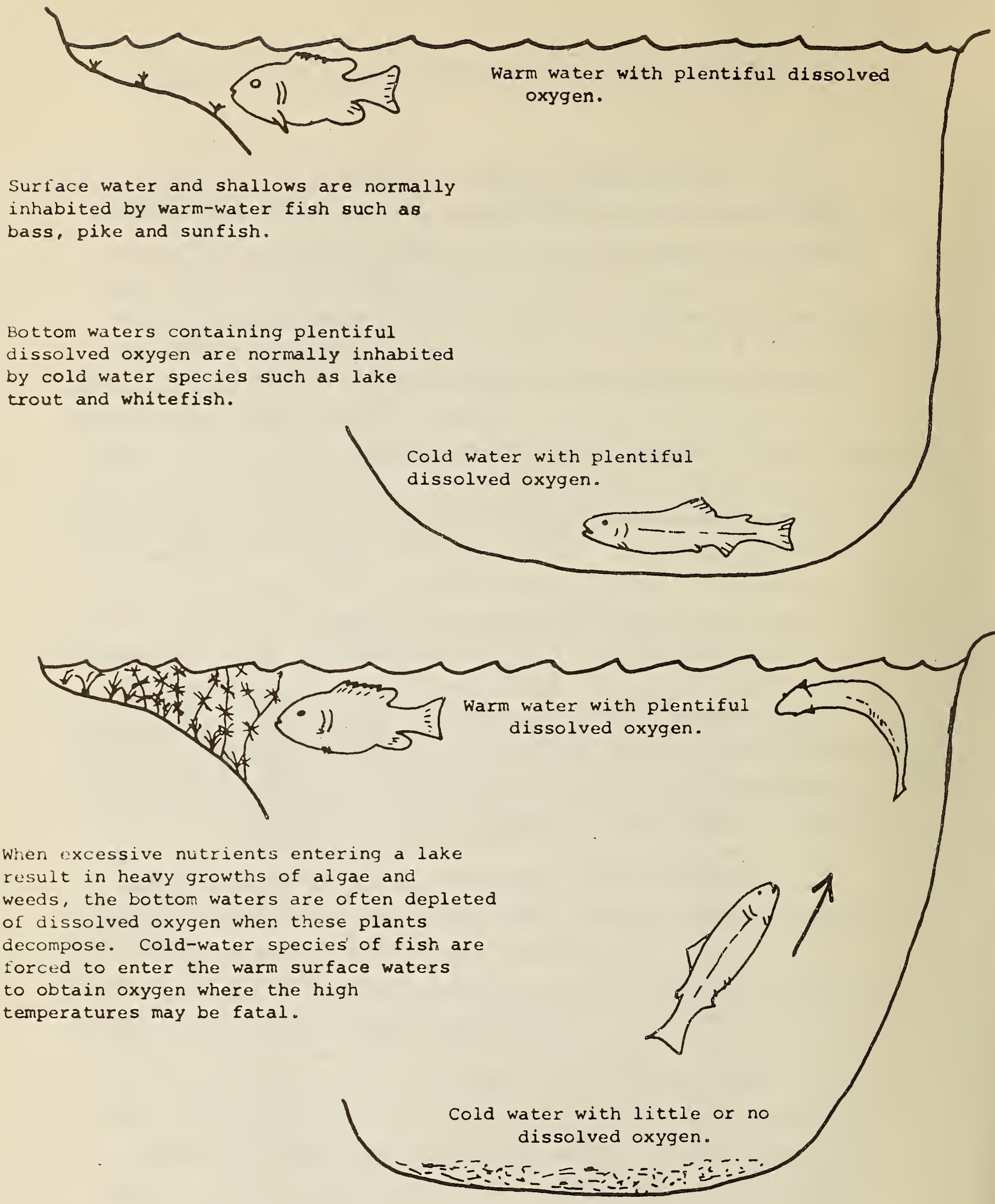


FIGURE A-1: DECOMPOSITION OF PLANT MATTER AT THE LAKE BOTTOM CAN LEAD TO DEATH OF DEEP-WATER FISH SPECIES.

Low oxygen conditions in the bottom waters are not necessarily an indication of pollution but excessive aquatic plant and algae growth and subsequent decomposition in the bottom waters can aggravate the condition and in some cases result in zero oxygen levels in lakes which had previously held some oxygen in the bottom waters all summer. Although plant nutrients normally accumulate in the bottom waters of lakes, they do so to a much greater extent if there is no oxygen present. These nutrients become available for algae in the surface waters when the lake mixes in the fall and dense algae growths can result. Consequently, lakes which have no oxygen in the bottom water during the summer are more prone to having algae problems and more vulnerable to nutrient inputs than lakes which retain some oxygen.

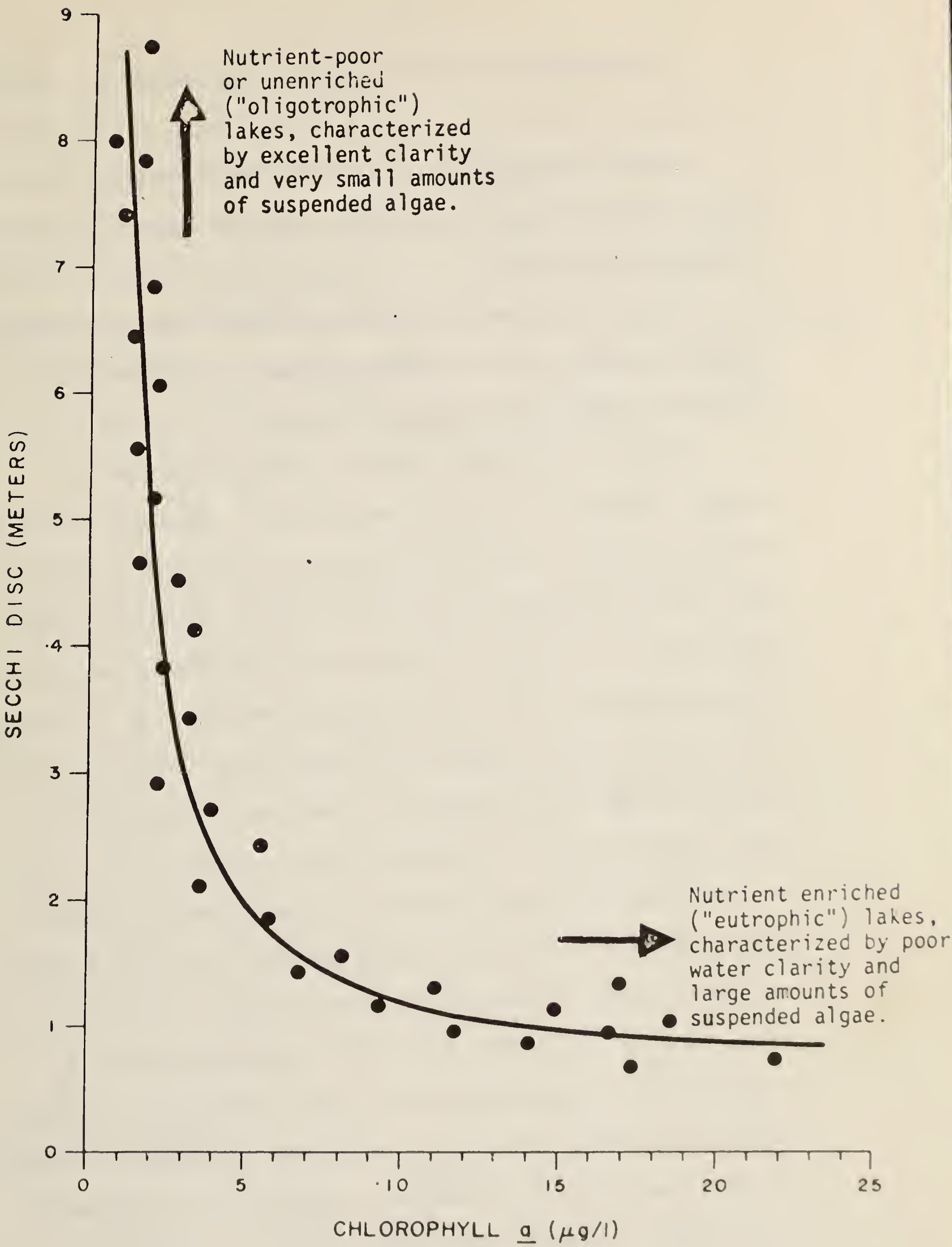
Like humans, aquatic plants and algae require a balanced "diet" for growth. Other special requirements including those for light and temperature are specific for certain algae and plants. Chemical elements such as nitrogen, phosphorus, carbon, and several others are required and must be in forms which are available for uptake by plants and algae. Growth of algae can be limited by scarcity of any single "critical" nutrient. Nitrogen and phosphorus are usually considered "critical" nutrients because they are most often in scarce supply in natural waters, particularly in lakes in the Precambrian area of the province. Phosphorus, especially is necessary for the processes of photosynthesis and cell division. Nitrogen and phosphorus are generally required in the nitrate-N (or ammonia-N) and phosphate forms and are present in natural land runoff and precipitation. Human and livestock wastes are a very significant source of these and other nutrients for lakes in urban and agricultural areas. It is extremely important that cottage waste disposal systems function so that seepage of nutrients to the lake does not occur since the changes in water quality brought about by excessive inputs of nutrients to lakes are usually evidenced by excessive growths of algae and aquatic plants.

The large amounts of suspended algae which materialize from excessive inputs of nutrients, result in turbid water of poor clarity or transparency. On the other hand, lakes with only small, natural inputs of nutrients and correspondingly low nutrient concentrations

(characteristically large and deep lakes) most often support very small amounts of suspended algae and consequently are clear-water lakes. An indication of the degree of enrichment of lakes can therefore be gained by measuring the density of suspended algae (as indicated by the chlorophyll a concentration - the green pigment in most plants and algae) and water clarity (measured with a Secchi disc). In this regard staff of the Ministry of the Environment have been collecting chlorophyll a and water clarity data from several lakes in Ontario and have developed a graphical relationship between these parameters which is being used by cottagers to further their understanding of the processes and consequences of nutrient enrichment of Precambrian lakes. The figure on the following page illustrates the above mentioned relationship.

In the absence of excessive coloured matter (eg. drainage from marshlands), lakes which are very low in nutrients are generally characterized by small amounts of suspended algae (ie. chlorophyll a) and are clear-water lakes with high Secchi disc values. Such lakes, with chlorophyll a and Secchi disc values lying in the upper lefthand area of the graph are unenriched or nutrient-poor ("oligotrophic") in status and do not suffer from the problems associated with excessive inputs of nutrients. In contrast, lakes with high chlorophyll a concentrations and poor clarity are positioned in the lower right-hand area of the graph and are enriched ("eutrophic"). These lakes usually exhibit symptoms of excessive nutrient enrichment including water turbidity owing to large amounts of suspended algae which may float to the surface and accumulate in sheltered areas around docks and bays.

Measurements of suspended algal density (chlorophyll a) and water clarity are especially valuable if carried out over several years. Year to year positional changes on the graph can then be assessed to determine whether or not changes in lake water quality are materializing so that remedial measures can be implemented before conditions become critical.


Nutrient-poor or unenriched ("oligotrophic") lakes, characterized by excellent clarity and very small amounts of suspended algae.
Nutrient enriched ("eutrophic") lakes, characterized by poor water clarity and large amounts of suspended algae.
SECCHI DISC (METERS)
CHLOROPHYLL a (μg/l)
0
1
2
3
4
5
6
7
8
9
0
5
10
15
20
25

CONTROL OF AQUATIC PLANTS AND ALGAE

Usually aquatic weed growths are heaviest in shallow shoreline areas where adequate light and nutrient conditions prevail.

Extensive aquatic plant and algal growths sometimes interfere with boating and swimming and ultimately diminish shoreline property values.

Control of aquatic plants may be achieved by either chemical or mechanical means. Chemical methods of control are currently the most practical, considering the ease with which they are applied. However, the herbicides and algicides currently available generally provide control for only a single season. It is important to ensure that an algicide or herbicide which kills the plants causing the nuisance, does not affect fish or other aquatic life and should be reasonable in cost. At the present time, there is no one chemical which will adequately control all species of algae and other aquatic plants. Chemical control in the province is regulated by the Ministry of the Environment and a permit must be granted prior to any operation. Simple raking and chain dragging operations to control submergent species hae been successfully employed in a number of situations; however, the plants soon re-establish

themselves. Removal of weed by underwater mowing techniques is certainly the most attractive method of control and is currently being evaluated in Chemung Lake near Peterborough. Guidelines and summaries of control methods, and applications for permits are available from the local district offices or the Southeastern Region, Ministry of the Environment, 133 Dalton Street, Kingston, Ontario K7L 4X6, Telephone 549-4000.

PHOSPHORUS AND DETERGENTS

Scientists have recognized that phosphorus is the key nutrient in stimulating algal and plant growth in lakes and streams.

In the past years, approximately 50% of the phosphorus contributed by municipal sewage was added by detergents. Federal regulations reduced the phosphate content as P_2O_5 in laundry detergents from approximately 50% to 20% on August 1, 1970 and to 5% on January 1, 1973.

It should be recognized that automatic dishwashing compounds were not subject to the government regulations and that surprisingly high numbers of automatic dishwashers are present in resort areas (a questionnaire indicated that about 30% of the cottages in the Muskoka Lakes have automatic dishwashers). Cottagers utilizing such conveniences may be contributing significant amounts of phosphorus to recreational lakes. Indeed, in most of Ontario's vacation land, the source of domestic water is soft enough to allow the exclusive use of liquid dishwashing compounds, soap and soap-flakes.

ONTARIO'S PHOSPHORUS REMOVAL PROGRAMME

By 1975, the Government of Ontario expects to have controls in operation at more than 200 municipal wastewater treatment plants across the province serving some 4.7 million persons. This represents about 90% of the population serviced with sewers. The programmes response to the International Joint Commission recommendations as embodied in the Great Lakes Water Quality Agreement and studies carried out by the Ministry of the Environment on inland recreational waters which showed phosphorus to be a major factor influencing eutrophication. The programmes makes provision for nutrient control in the Upper and Lower Great Lakes, the Ottawa River system and in prime recreational waters where the need is demonstrated or where emphasis is placed upon prevention of localized eutrophication.

Phosphorus removal facilities became operational at wastewater treatment plants on December 31, 1973, in the most critically affected areas of the province, including all of the plants in the Lake Erie drainage basin and the inland recreational areas. The operational date for plants discharging to waters deemed to be in less critical condition, which includes plants larger than one million gallons per day (1 mgd) discharging to Lake Ontario and to the Ottawa River System, is December 31, 1975. The 1973 phase of the program involved 113 plants, of which 48 are in prime recreational areas. An additional 53 new plants, each with phosphorus removal, are now under development, 23 of which are located in recreational areas. The capacities of these plants range from 0.04 to 24.0 mgd, serving an estimated population of 1,600,000 persons.

The 1975 phase will bring into operation another 54 plants ranging in size from 0.3 to 180 mgd serving an additional 3,100,000 persons. Treatment facilities utilizing the Lower Great Lakes must meet effluent guidelines of less than 1.0 milligram per litre of total phosphorus in their final effluent. Facilities utilizing the Upper Great Lakes, the Ottawa River Basin and certain areas of Georgian Bay where needs have been demonstrated must remove at least 80% of the phosphorus reaching their sewage treatment plants.

CONTROL OF BITING INSECTS

Mosquitoes and blackflies often interfere with the enjoyment of recreational facilities at the lake-side vacation property. Pesticidal spraying or fogging in the vicinity of cottages produces extremely temporary benefits and usually do not justify the hazard involved in contaminating the nearby water. Eradication of biting fly populations is not possible under any circumstances and significant control is rarely achieved in the absence of large-scale abatement programmes involving substantial funds and trained personnel. Limited use of approved larvicides in small areas of swamp or in rain pools close to residences on private property may be undertaken by individual landowners, but permits are necessary wherever treated waters may contaminate adjacent streams or lakes. The use of repellents and light traps is encouraged as are attempts to reduce mosquito larval habitat by improving land drainage. Applications for permits to apply insecticides as well as technical advice can be obtained from the local district offices or the Southeastern Region, Ministry of the Environment, 133 Dalton Street, Kingston, Ontario K7L 4X6, Telephone 549-4000.

QH/96.8/E9/C67/1976/MOE
Galloway, D L
Cottagers self -
help program
aqgz
c.1 a aa